



## Canadian Neutron Initiative roundtable towards a National Neutron Strategy

A virtual meeting produced by the Canadian Institute For Advanced Research (CIFAR) and the

### Event Description

**Meeting Page:** <https://events.cifar.ca/ehome/index.php?eventid=569478&>

**Primary Purpose:** To engage a cross-section of stakeholders and leading scientists to shape a national neutron strategy to rebuild Canadian capacity for materials research with neutron beams. Ideas and feedback will be sought on key elements of the strategy, including the needed infrastructure and associated programs, domestic and foreign, on multiple time scales.

**Secondary Purpose:** To learn from experiences of organizations that facilitate national participation in research infrastructure at distributed locations, including partnerships with international facilities.

#### Participants:

- Neutron-beam users, including Fellows of CIFAR's Quantum Materials (QMT) program, Canada Research Chairs and early-career researchers
- University executive leaders
- Federal government innovation and science departments and agencies
- Representatives of international neutron facilities that could be resources for the strategy
- Selected representatives of organizations that facilitate national participation in domestic and international research infrastructure

**Day 1:** Tuesday, December 15, 2020 from 12:30 to 15:40 Eastern Time

- Session 1: Need for a national neutron strategy – from disruption to cohesion
- Session 2: Forging foreign partnerships in the short-term
- Session 3: Domestic activities in a program relying on foreign facilities

**Day 2:** Wednesday, December 16, 2020 from 12:30 to 15:40 Eastern Time

- Session 4: Building on domestic capabilities in the medium-term
- Session 5: Explore new sources and options for the long-term
- Session 6: (Facilitated Discussion) "A national neutron strategy"

#### Primary reference documents circulated in advance of the meeting:

- "Discussion on a National Neutron Strategy"
- Report on the Neutrons Canada Roundtable (Ottawa, 2020 Jan 29)

#### Sponsors:



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**Agenda – DAY 1**

Time	Speaker	Topic(s)
<b>Preliminaries</b> Facilitator: Fiona Cunningham (CIFAR, Director, Innovation)		
12:35	Karen Chad, USask VPR and Chair of Canadian Neutron Initiative (CNI) Working Group	Welcome and Introductions
12:40	Fiona Cunningham, CIFAR moderator	Ground rules for virtual meeting; brief introduction to CIFAR and QMT program
<b>Session 1: (Presentations) Need for a national neutron strategy – from disruption to cohesion</b> Facilitator: Fiona Cunningham (CIFAR, Director, Innovation)		
12:45	Fiona Cunningham, CIFAR moderator	Introduce Speakers for Session 1
12:50	John Root, Fedoruk Centre (representing CNI Working Group)	Introduce context: Canadian Neutron Initiative (CNI); Neutrons Canada; purpose of this event
13:05	Daniel Banks, TVB Associates Inc. (representing CNI Working Group)	Impact of materials research with neutron beams; historical and policy context for a strategic plan
<b>Session 2: (Presentations + Facilitated Discussion) Forging partnerships with high-brightness neutron sources in other countries in the short term</b> Co-Facilitators: Prof. Young-June Kim, University of Toronto, Physics and Prof. Pat Clancy, McMaster University		
13:20	Fiona Cunningham, CIFAR moderator	Introduce Young-June Kim and Pat Clancy, Co-Facilitators and Speakers for Session 2
13:25	Thad Harroun, CINS President and Professor, Brock University	Current challenges faced by academic users to access foreign facilities
13:35	Ron Rogge, R&D Scientist, Canadian Nuclear Laboratories	Impacts of materials research with neutron beams in the nuclear industry; what industry users need
13:45	Helmut Schober, ILL; Chair of LENS	Partnership opportunities at European neutron sources
13:55	Rob Dimeo, Director of the NIST Center for Neutron Research	Partnership opportunities at US neutron facilities
14:05	Facilitated discussion among all participants: <ul style="list-style-type: none"> <li>• How can Canada best support the full range of users, including expert and non-expert users from universities, government labs, and industry, to access foreign neutron beam facilities?</li> <li>• How should Canada make the decision on what partnerships to forge and how much to invest in each?</li> <li>• What role should Neutrons Canada, which is to be established as a national organization with institutional members, play in such decisions and in negotiating the arrangements with the partners?</li> </ul>	
14:35	Break (10 min)	

<b>Session 3: (Presentations + Facilitated Discussion) Operating a pan-Canadian program for materials research with neutron beams that relies on foreign neutron sources</b> Facilitator: Daniel Banks, PhD, MBA, President, TVB Associates Inc.		
14:45	Daniel Banks, TVB Associates Inc. (representing CNI Working Group)	Introduce speakers for Session 3
14:50	Thomas Brückel, Director, Jülich Centre for Neutron Science	German experience in operating a virtual institute for neutron scattering
15:00	Luc Simard, Director General, Herzberg Institute of Astrophysics, National Research Council of Canada (NRC)	NRC roles in facilitating participation in international telescopes
15:10	Jonathan Bagger, Director of TRUMF	Operating a pan-Canadian program in nuclear physics combining domestic and foreign facilities
15:20	Facilitated discussion among all participants: <ul style="list-style-type: none"> <li>• What activities to support access to foreign neutron sources should be conducted within a Canadian program, as opposed to outsourcing to a foreign partner?</li> <li>• How can Canada best retain, leverage, and plan for succession of its scientific and technical expertise in neutron beam instrumentation and methods?</li> <li>• What roles should a national entity, Neutrons Canada, play in operating such a program? What are the benefits of having a national organization perform functions such as: (a) Planning and shepherding major neutron initiatives through decision-making processes and implementing major neutron initiatives? (b) Governing and managing a national program for user access to neutron beam facilities, both domestic and foreign? (c) Negotiating with foreign facilities? (d) Maintaining the continuity of expertise needed to support both (i) the operations of neutron facilities, and (ii) the implementation of capital projects?</li> <li>• What is the potential value of centralized efforts to engage industry in (i) applying neutron beams, (ii) supplying services to develop neutron beam facilities, and (iii) spinning-off technologies?</li> <li>• What value can a neutron beam program contribute to science outreach to youth and the general public?</li> </ul>	
15:50	Adjourn until Day 2	

**Agenda – DAY 2**

Time	Speaker	Topic(s)
<b>Preliminaries</b>		
Facilitator: <a href="#">Fiona Cunningham (CIFAR, Director, Innovation)</a>		
12:30	Karen Chad, USask VPR and Chair of CNI Working Group	Welcome and Introductions
12:35	Fiona Cunningham, CIFAR moderator	Review of ground rules for virtual meeting, and intro to CIFAR and QMT (introduce Anne and Alannah)
12:40	Anne Ballantyne, Fedoruk Centre (representing CNI Working Group)	Summarize highlights of discussions from Day 1.
<b>Session 4: (Presentations + Facilitated Discussion) Building on domestic capabilities in the medium-term</b>		
Facilitator: <a href="#">Alannah Hallas, Assistant Professor, Physics &amp; Astronomy and Principal Investigator, Quantum Matter Institute, University of British Columbia</a>		
12:45	Alannah Hallas, UBC and QMT	Introduce speakers for Session 4
12:50	Bruce Gaulin, Distinguished Professor, McMaster University, and QMT	Building a domestic neutron beam lab at the McMaster Nuclear Reactor (MNR)
13:00	John Root, Fedoruk Centre	Fostering pan-Canadian leadership
13:10	Alannah Hallas, University of British Columbia (UBC) and QMT	EDI considerations as part of building a pan-Canadian neutrons program
13:15	<p>Facilitated discussion among all participants:</p> <ul style="list-style-type: none"> <li>• What benefits could the MNR provide as a domestic facility that we may miss by relying exclusively on partnerships with foreign neutron sources?</li> <li>• In what other ways can Canada strengthen its domestic capabilities?</li> <li>• What role should Neutrons Canada play in fully exploiting the MNR, in fostering domestic expertise, and in otherwise building Canada's domestic capabilities?</li> </ul> <p>EDI questions:</p> <ul style="list-style-type: none"> <li>• What role can a national neutron strategy play in promoting equity, diversity, and inclusion, recognizing that groups such as women, racial and ethnic minorities, Indigenous communities, and persons with disabilities are presently underrepresented in the neutron beam community?</li> <li>• What role can a national neutron strategy play in fostering expertise among atypical users, such as researchers from less research-intensive institutions, including smaller, rural, and Northern universities, colleges, and polytechnics?</li> <li>• How can we ensure that the needs of these users are considered? How can Canada ensure equity, diversity, and inclusion in the neutron beam user community while relying on access to foreign facilities?</li> <li>• When new neutron beam infrastructure is to be constructed in Canada, how can local and Indigenous communities be engaged to ensure a meaningful partnership?</li> </ul>	
13:45	Break (5 min)	

<b>Session 5: (Presentations + Facilitated Discussion)</b> Explore new sources and options for the long-term Facilitator: Dr. John Root, Executive Director, Sylvia Fedoruk Canadian Centre for Nuclear Innovation (Fedoruk Centre)		
13:50	John Root, Fedoruk Centre (representing CNI Working Group)	Introduce speakers for Session 5
13:55	Andreas Schreyer, Director for Science, ESS	The ESS and prospects for the new neutron sources in Europe
14:05	Ken Andersen, ORNL Director, Neutron Technologies Division	Prospects for new neutron sources in the US
14:15	Drew Marquardt, Professor, U. Windsor	Feasibility study for an alternative neutron source for Canada
14:25	Carlos Lorencez, Director, Nuclear Safety and Environmental Affairs, CANDU Owners Group	Nuclear industry drivers for a research reactor
14:35	Facilitated discussion among all participants <ul style="list-style-type: none"> <li>• What are the benefits of participating in multinational consortia to plan and build new neutron sources?</li> <li>• What are the benefits of developing a new domestic neutron source that are not achievable through such participation in multinational consortia?</li> <li>• How can the Canadian neutron beam community prepare to participate in national decision-making processes about new neutron sources, as a coherent constituency alongside the nuclear power and isotope production communities?</li> <li>• What role should Neutrons Canada play in planning for new neutron sources for the long term? Or in research, development, and demonstration projects for such sources?</li> </ul>	
15:05	Break (5 min)	
<b>Session 6: (Facilitated Discussion) “A National Neutron Strategy”</b> Facilitator: Janet Halliwell, President, J.E. Halliwell Associates Inc.		
15:10	Fiona Cunningham, CIFAR moderator	Introduce speaker for Session 6
15:15	Gather feedback on the national neutron strategy document, inviting comments on discussion questions and topics that may not have been covered earlier. Identify next steps.	
15:50	Karen Chad, USask VPR and Chair of CNI Working Group	Final adjournment

### **Background on the Canadian Neutron Initiative**

Canada's long-term competitiveness relies on a complete twenty-first century scientific toolkit to develop materials for innovation in priority areas, such as producing and storing clean energy, growing the economy through advanced manufacturing and clean technologies, and promoting health through biomedical and life sciences. Neutron beams are irreplaceable and versatile tools for materials research, and Canadians have been applying them to make major socio-economic impacts in these priority areas for several decades. The impacts range from bolstering Canada's scientific reputation in Nobel Prize-winning science to saving hundreds of millions of dollars by reducing downtimes of Canada's fleet of nuclear power stations. Canada lost access to neutron beams in 2018, when the country's only major domestic neutron source, the NRU reactor in Chalk River, was closed permanently without a plan for its replacement. In parallel, Canada lost its national coordinating organization, the Canadian Neutron Beam Centre, as well as an arrangement for access to the Spallation Neutron Source in the USA. Suddenly, Canadian scientists from universities and industries are much more limited to apply neutron-beam methods to advance materials research and education.

In 2015, the Canadian scientific community initiated the Canadian Neutron Initiative (CNI), aiming to establish a new, pan-Canadian, university-led framework for stewardship of Canada's capability for research with neutron beams, and thereby enable a national neutron scattering program to continue beyond 2018. The CNI working group was founded by the VPs of Research of the University of Saskatchewan (Karen Chad, Chair) and McMaster University (Rob Baker), the President of the Canadian Institute for Neutron Scattering (the user community - Thad Harroun), and the CEO of the Canadian Nuclear Association (CNA). In 2019, the VP Research of the University of Windsor (Michael Siu) joined the working group and the CNA has stepped back for the next phase.

### **Background on University Leadership and progress towards a new national program**

In January 2020, VPs or Associate VPs of Research from sixteen Canadian universities met<sup>1</sup> and reached a consensus that: Canada should maintain its leadership role in materials research with neutron beams; Canadian universities need to establish a pan-Canadian, university-led framework to govern, manage, and represent Canada's program for materials research with neutron beams; and Canadian university Vice-Presidents of Research should devote their own time and attention to help shape this new framework and to ensure ongoing engagement of their universities as Institutional Members.

Four elements must be addressed in a strategy to rebuild Canadian capacity for materials research with neutron beams:

1. Building on existing domestic capabilities, including full exploitation of the McMaster Nuclear Reactor (MNR), a medium-brightness neutron source;
2. Forging partnerships with high-brightness neutron sources in other countries;
3. Exploring investment in new domestic neutron sources for the long term; and
4. Creating a new, national governance and management framework for these activities.

University-led activities are already underway for each of these elements. A critical priority is to restore some access to neutron beams for Canadian researchers as soon as possible through elements 1 and 2 of a national strategy. For this purpose, **McMaster University** led a proposal to the Canada Foundation for Innovation (CFI) 2020 Innovation Fund competition for a \$47M infrastructure project with domestic and foreign components and 17 universities have contributed portions of their CFI grant request quotas to this proposed project. This project would be a major step forward, but a full-scale national program

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<sup>1</sup> [Canadian Leadership in Materials Research with Neutron Beams - Report on a Roundtable Meeting towards the establishment of "Neutrons Canada" \(2020 January\).](#)

(excluding reinvestment in neutron sources) is expected to cost \$20M per year to operate. This scale of operation is more than can be sustained through existing science funding programs. The federal finance committee endorsed a request from the CNI working group for support of a national program, during budget considerations in 2017 and in 2018. However, the federal budget has not included a direct allocation for this purpose.

Around the world, countries are reinvesting in neutron sources because the supply of neutron beams is shrinking as older sources retire. Canada will need to reinvest in order to continue as a participant in this field over the long term (element 3 of a national strategy). Options include major contributions to new multi-national sources (e.g. to the ESS or to the second target station at the SNS) or to a new domestic facility, which could range from a \$500M dedicated neutron beam reactor to \$1–\$2B for a multipurpose research reactor or a spallation source. A further option could be Compact Accelerator-based Neutron Sources (CANS), a technology concept that is proposed for lower-cost medium-brightness neutron sources. The **University of Windsor** is currently leading a feasibility study for a prototype CANS.

The CNI working group, chaired by the VP Research at the **University of Saskatchewan**, is transitioning to act as the steering committee to create a new entity, “Neutrons Canada,” which is an essential feature of strategic element 4. Neutrons Canada would govern, manage, and represent Canada’s program for materials research with neutron beams. This program will be of a scale and complexity to qualify it as a Major Research Facility (MRF), in the class of TRIUMF and the Canadian Light Source.

Today’s event “Canadian Neutron Initiative roundtable towards a National Neutron Strategy” gathers leading scientists from universities and industry, government agencies, and international facilities to shape the ‘what’ and ‘how’ of a national program for the coming decades.

### **Background on CIFAR**

CIFAR’s [Quantum Materials](#) (QMT) program brings together some of the world’s leaders in both theory and experimentation in condensed matter physics, chemistry and materials science, to explore exotic and unexpected behaviours of materials that arise due to the quantum nature of matter. Over nearly three decades, QMT researchers have created new understanding in superconductivity, magnetism and other properties of materials that is contributing to advances in quantum technology, a major source of innovation in the coming years.

By supporting long-term interdisciplinary collaboration, CIFAR’s model inspires new directions of inquiry and yields breakthroughs across borders and academic disciplines. Additionally, CIFAR is committed to supporting technological innovation alongside industrial R&D leaders, governments and public institutions. To support the societal impact of the program, QMT fellows have identified the field of advanced measurements and instrumentation, including the neutron scattering community, as a key stakeholder group to engage. Convening QMT fellows with academic, industrial and policy experts to discuss the future of neutron facilities in Canada will thus create an opportunity to contribute to both fundamental research in quantum materials as well as industrial applications of neutron scattering.

### **Background on ESS**

The European Spallation Neutron Source (ESS) hosted a high-level roundtable discussion on Canadian and Swedish collaboration across science, industry, and research infrastructures in February 2017. The discussion was held as part of a state visit by the Governor General of Canada, included the King of Sweden and the science ministers of both Sweden and Canada, highlighting the broad impact that research infrastructures have on the two nations. In November 2017, the CNI organized a delegation of Canadian neutron scientists to visit the ESS and further explore opportunities for cooperation between ESS and Canada. The Canadians met with representatives of the Swedish and Danish ministries for science and research as well as the Swedish Research Council, neutron scientists from ESS partner

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institutes in Sweden and Denmark, a broad group of ESS staff scientists and management, the chair of the ESS Scientific Advisory Committee, and both the ESS Council chair and vice-chair. The Canada-ESS partnership continues to grow and flourish through sharing of practices with the CNI Working group, Canada's neutron beam community, and participation in the upcoming International Conference on Research Infrastructures (ICRI), June 2-4, 2021 in Ottawa, Canada.